

疏花毛萼香茶菜中一新的对映 – 贝壳杉烷型二萜

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摘要: 从疏花毛萼香茶菜 (*Isodon eriocalyx* var. *laxiflora*) 叶中分离得到一新的对映 – 贝壳杉烷型二萜, 命名为疏花丁素(1), 通过波谱方法鉴定了它的结构。此外, 还分离得到 6 个已知对映 – 贝壳杉烷型二萜化合物: 疏花甲素(2), 毛萼晶 A – C(3~5) 和 Q(6), 毛萼乙素(7), 以及 cirsimaritin(8) 和 2 α – 羟基乌索酸(9)。

关键词: 疏花毛萼香茶菜; 唇形科; 对映 – 贝壳杉烷型二萜; 疏花丁素

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A New *ent* – Kauranoid from *Isodon eriocalyx* var. *laxiflora*

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Abstract: A new *ent* – kauranoid named laxiflorin D(1) was isolated from the leaves of *Isodon eriocalyx* var. *laxiflora*, whose structure was determined by the spectroscopic methods. Six known *ent* – kaurane diterpenoids, laxiflorin A(2), maoecrystals A – C(3~5), Q(6) and eriocalyxin B(7), together with cirsimaritin(8) and 2 α – hydroxyursolic acid(9), were also isolated.

Key words: *Isodon eriocalyx* var. *laxiflora*; Labiatae; *ent* – Kauranoid; Laxiflorin D

Isodon eriocalyx (Dunn) Hara var. *laxiflora* C. Y. Wu et H. W. Li, a perennial shrub widely distributed in Yunnan Province, has the efficacy of expelling toxin by cooling and stopping diarrhea. A series of *ent* – kaurane diterpenoids from this plant have been reported previously (Shen *et al*, 1986; Sun *et al*, 1995). However, the material we studied is quite special because its seeds had been brought into the firmament. We want to know whether there are any changes in chemical constituents after such a journey. Investigation on this special plant led to the isolation of a new diterpenoid, laxiflorin D(1) and eight known compounds, laxiflorin A(2) (Sun *et al*, 1995), maoecrystals A – C(3~5) (Li *et al*, 1988), Q(6) (Wang *et al*, 1997), eriocalyxin B(7) (Wang *et al*, 1982), cirsimaritin(8) (Wallace, 1971) and 2 α – hydroxyursolic acid(9).

laxiflorin D(1), colorless crystals, had a molecular formula of C₂₀H₂₄O₅ deduced from positive

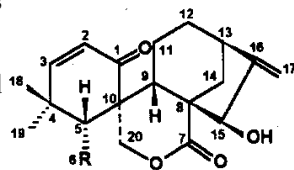
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HRFABMS (obsd 345.1771, calcd 345.1702). It possessed an *exo*-methylene [^1H NMR: δ 5.15 and 5.40 (each 1H, br s), ^{13}C NMR: δ 109.5 (t) and 159.8 (s)], a α , β -unsaturated ketone [^1H NMR: δ 5.95 and 6.46 (each 1H, d, J = 10.2 Hz), ^{13}C NMR: δ 125.3, 157.2 (each d) and 198.8 (s)], a lactonic carbonyl group (δ 175.0, s) and an aldehyde group [^1H NMR: δ 10.2 (1H, d, J = 4.7 Hz), ^{13}C NMR: δ 201.7 (d)]. Furthermore, three quaternary carbons, four methines including an oxygen-bearing one, four methylenes including an oxygenated one and two tertiary methyls were also shown in ^{13}C NMR spectrum of **1**. By comparing these data above with those of laxiflorin A (**2**), the same skeleton of 15β -hydroxy-1-oxo-6,7-seco-*ent*-kaur-2,16-dien-7,20-olide as **2** was established. The difference between them was an observation of the signals ascribable to the aldehyde group in **1** instead of those due to a hydroxymethyl in **2**. Moreover, the signals of H-5 in **1** shifted downfield and changed from a doublet of doublet in **2** into a doublet in **1**. Simultaneously, the chemical shift of C-5 also shifted downfield in **1**. So, the aldehyde group was located at C-6 of **1**. The β -orientation of 15-OH was confirmed by the upfield shift of C-9 (δ 37.5) owing to the γ -steric compression effect between H-9 β and 15β -OH. In conclusion, laxiflorin D (**1**) was characterized as 15β -hydroxy-1,6-dioxo-6,7-seco-*ent*-kaur-2,16-dien-7,20-olide.

Compounds **2**~**9** were identified as laxiflorin A (**2**), maoecrystals A-C (**3**~**5**), Q (**6**), eriocalyxin B (**7**), cirsimaritin (**8**) and 2α -hydroxyursolic acid (**9**), respectively, by comparing their physical and spectral data with those reported in the literature.

From the isolates above, we can conclude that no particular differences in the structural types between this unusual plant and the normally growing shrub (Shen *et al*, 1986; Sun *et al*, 1995) appear.



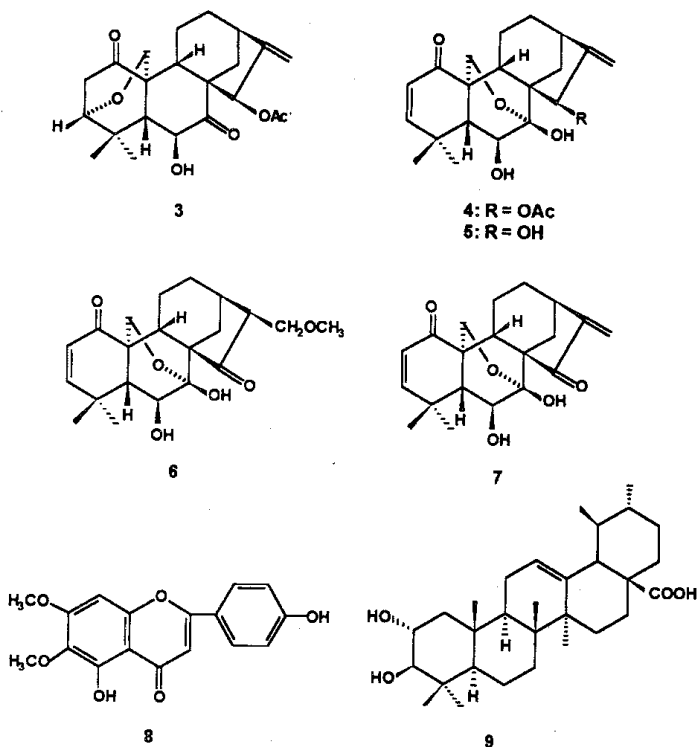
1: R = CHO
2: R = CH₂OH

Experimental

General All melting points were measured on an XRC-1 micro melting point apparatus and uncorrected. Optical rotation was taken on a SEPA-300 polarimeter. IR spectral data were measured on a Bio-Rad FTS-135 spectrometer with KBr pellets. UV spectra were obtained on a UV 210A spectrometer. MS spectra were recorded on a VG Auto Spec-3000 spectrometer. NMR spectra were run on a Bruker AM-400 and a DRX-500 instrument with TMS as internal standard.

Plant Material The leaves of *I. eriocalyx* (Dunn) Hara var. *laxiflora* C. Y. Wu et H. W. Li were collected in Kunming Botanical Garden in September, 1994, and air-dried. Before sowing, the seeds were brought into the firmament and then were planted on the earth. The identity of plant material was verified by Prof. Zhong-Wen Lin, and a voucher specimen (KIB 94-09-15) is deposited in the Herbarium of Kunming Institute of Botany, Chinese Academy of Sciences.

Extraction and Isolation The dried and powdered leaves (1.1 kg) were extracted with MeOH under reflux and concentrated. The extract (158 g) was subjected to Si gel column chromatography eluting with petrol, petrol-chloroform, chloroform and chloroform-acetone to give seven fractions.



Fractions III – V were further purified by repeated column chromatography on Si gel and recrystallization to yield **1** (500 mg), **2** (600 mg), **3** (1.3 g), **4** (430 mg), **5** (115 mg), **6** (50 mg), **7** (200 mg), **8** (65 mg) and **9** (40 mg).

Laxiflorin D (**1**), $C_{20}H_{24}O_5$; mp 242 ~ 244 °C; $[\alpha]_D^{25} + 137.6^\circ$ (c 0.62, C_5H_5N); $UV\lambda_{max}^{MeOH}$ nm (log ϵ): 229 (4.05); $IR\nu_{max}^{KBr} cm^{-1}$: 3520, 2970, 2942, 2868, 1732, 1715, 1658, 1268, 1241; EIMS (70 eV) m/z (%): 344 [M]⁺ (2), 326 [M – H₂O]⁺ (1), 316 [M – CO]⁺ (7), 301 (4), 285 (8), 270 (4), 255 (4), 165 (18), 149 (35), 77 (100); positive HRFABMS m/z : 345.1771, calcd for $C_{20}H_{25}O_5$ 345.1702; 1H NMR and ^{13}C NMR data, see Table 1.

Laxiflorin A (**2**), $C_{20}H_{26}O_5$; EIMS (70 eV) m/z (%): 346 [M]⁺ (16), 328 [M – H₂O]⁺ (1), 315 [M – CH₂OH]⁺ (9), 287 (6), 257 (2), 227 (3), 175 (7), 167 (29), 149 (33), 135 (100); 1H NMR (500 MHz, C_5D_5N): δ 5.94 (1H, d, J = 10.2 Hz, H-2), 6.50 (1H, d, J = 10.2 Hz, H-3), 2.43 (1H, dd, J = 3.4, 4.8 Hz, H-5), 4.30 (1H, dd, J = 3.4, 11.7 Hz, H-6a), 4.08 (1H, dd, J = 4.8, 11.7 Hz, H-6b), 3.39 (1H, dd, J = 5.0, 12.8 Hz, H-9 β), 1.62 (1H, m, H-11 α), 1.60 (1H, m, H-11 β), 1.50 (1H, m, H-12 α), 2.01 (1H, ddd, J = 6.9, 11.0, 13.0 Hz, H-12 β), 2.71 (1H, t, J = 6.5 Hz, H-13 α), 2.59 (1H, d, J = 12.1 Hz, H-14 α), 2.39 (1H, m, H-14 β), 5.02 (1H, s, H-15 α), 5.46 (1H, s, H-

17a), 5.19(1H, s, H-17b), 1.20(3H, s, Me-18), 1.27(3H, s, Me-19), 5.42(1H, d, J = 10.6 Hz, H-20a), 4.69(1H, d, J = 10.6 Hz, H-20b); ¹³C NMR(125 MHz, C₅D₅N): δ201.9(s, C-1), 124.8(d, C-2), 159.3(d, C-3), 36.8(s, C-4), 48.1(d, C-5), 58.6(t, C-6), 176.0(s, C-7), 53.4(s, C-8), 36.8(d, C-9), 52.1(s, C-10), 17.5(t, C-11), 33.7(t, C-12), 35.6(d, C-13), 31.6(t, C-14), 82.7(d, C-15), 160.7(s, C-16), 109.0(t, C-17), 32.4(q, C-18), 24.2(q, C-19), 70.2(t, C-20).

Table 1 ¹H NMR and ¹³C NMR data for 1 in C₅D₅N

proton	¹ H NMR(500 MHz) δ(mult, J in Hz)	carbon	¹³ C NMR(125 MHz) δ(mult)
2	5.95(d, 10.2)	1	198.8(s)
3	6.46(d, 10.2)	2	125.3(d)
5β	3.17(d, 4.7)	3	157.2(d)
6	10.2(d, 4.7)	4	36.3(s)
9β	2.81(dd, 5.2, 12.8)	5	58.5(d)
11α	1.57(m)	6	201.7(d)
11β	1.51(m)	7	175.0(s)
12α	1.96(td, 7.6, 12.1)	8	53.1(s)
12β	1.40(m)	9	37.5(d)
13α	2.66(t, 5.9)	10	49.9(s)
14α	2.45(d, 12.2)	11	17.1(t)
14β	2.38(dd, 5.1, 12.2)	12	33.2(t)
15α	4.98(br s)	13	36.5(d)
17a	5.40(br s)	14	31.2(t)
17b	5.15(br s)	15	82.3(d)
Me-18	1.67(s)	16	159.8(s)
Me-19	1.67(s)	17	109.5(t)
20a	5.54(d, 10.6)	18	31.2(q)
20b	5.00(d, 10.6)	19	23.8(q)
		20	68.9(t)

Maoecrystal A (3), C₂₂H₂₈O₆; mp 167 ~ 169°C; IR_{max}^{KBr} cm⁻¹: 3440, 2920, 1727, 1708, 1657, 1362, 1226, 1053; EIMS(70 eV) m/z(%): 388[M]⁺(42), 370[M - H₂O]⁺(9), 360(1), 345(100), 328(74), 318(9), 310(5), 300(13), 286(23), 269(11), 258(17), 243(17), 229(40), 215(55); ¹H NMR(400 MHz, CDCl₃): δ3.68(1H, dd, J = 2.1, 3.4 Hz, H-3β), 4.63(1H, dd, J = 2.8, 6.4 Hz, H-6α), 2.92(1H, br d, J = 8.0 Hz, H-9β), 2.77(1H, br s, H-13α), 6.15(1H, t, J = 2.6 Hz, H-15α), 5.03(1H, br s, H-17a), 5.00(1H, br s, H-17b), 1.46(3H, s, Me-18), 1.05(3H, s, Me-19), 4.65(1H, d, J = 10.0 Hz, H-20a), 4.07(1H, dd, J = 1.4, 10.0 Hz, H-20b), 2.12(3H, s, CH₃COO); ¹³C NMR(100 MHz, CDCl₃): δ208.3(s, C-1), 41.7(t, C-2), 77.0(d, C-3), 37.6(s, C-4), 51.8(d, C-5), 71.0(d, C-6), 209.6(s, C-7), 55.8(s, C-8), 39.6(d, C-9), 51.4(s, C-10), 20.4(t, C-11), 32.5(t, C-12), 34.9(d, C-13), 35.8(t, C-14),

73.9 (d, C-15), 149.7 (s, C-16), 108.8 (t, C-17), 29.2 (q, C-18), 22.9 (q, C-19), 62.0 (t, C-20), 20.9 (q, CH_3COO), 170.1 (s, CH_3COO).

Maoecrystal B (**4**), $\text{C}_{22}\text{H}_{28}\text{O}_6$; mp 196 ~ 198 °C; $\text{UV}_{\text{KBr}}^{\text{MeOH}}$ 222.5 nm; $\text{IR}_{\text{max}}^{\text{KBr}} \text{cm}^{-1}$: 3510, 3340, 2938, 1700, 1647, 1260, 1060, 1037; EIMS (70 eV) m/z (%): 388 [M]⁺ (63), 371 (5), 359 (7), 345 (9), 328 (15), 310 (9), 299 (13), 281 (17), 267 (12), 205 (13), 165 (41), 135 (37), 96 (100); $^1\text{H NMR}$ (400 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 6.06 (1H, d, J = 10.0 Hz, H-2), 6.75 (1H, d, J = 10.0 Hz, H-3), 4.36 (1H, d, J = 8.2 Hz, H-6 α), 6.30 (1H, t, J = 2.4 Hz, H-15 α), 5.16 (1H, br s, H-17a), 5.11 (1H, br s, H-17b), 1.42 (3H, s, Me-18), 1.14 (3H, s, Me-19), 4.61 (1H, d, J = 9.5 Hz, H-20a), 4.20 (1H, dd, J = 1.5, 9.5 Hz, H-20b), 2.27 (3H, s, CH_3COO); $^{13}\text{C NMR}$ (100 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 198.5 (s, C-1), 127.8 (d, C-2), 160.5 (d, C-3), 35.9 (s, C-4), 53.4 (d, C-5), 73.4 (d, C-6), 97.6 (s, C-7), 52.6 (s, C-8), 43.2 (d, C-9), 46.8 (s, C-10), 18.5 (t, C-11), 32.4 (t, C-12), 36.1 (d, C-13), 27.3 (t, C-14), 75.2 (d, C-15), 159.5 (s, C-16), 108.7 (t, C-17), 30.5 (q, C-18), 24.7 (q, C-19), 65.5 (t, C-20), 22.0 (q, CH_3COO), 170.8 (s, CH_3COO).

Maoecrystal C (**5**), $\text{C}_{20}\text{H}_{26}\text{O}_5$; mp 204 ~ 206 °C; $\text{UV}_{\text{max}}^{\text{MeOH}}$ 226.5 nm; $\text{IR}_{\text{max}}^{\text{KBr}} \text{cm}^{-1}$: 3360, 3160, 2910, 1700, 1650, 1119, 1067, 1040; EIMS (70 eV) m/z (%): 346 [M]⁺ (91), 328 [M - H₂O]⁺ (40), 300 (46), 285 (29), 205 (44), 165 (89), 135 (80), 96 (100); $^1\text{H NMR}$ (400 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 5.97 (1H, d, J = 10.0 Hz, H-2), 6.67 (1H, d, J = 10.0 Hz, H-3), 4.36 (1H, d, J = 7.3 Hz, H-6 α), 5.06 (1H, br s, H-15 α), 5.48 (1H, br s, H-17a), 5.20 (1H, br s, H-17b), 1.34 (3H, s, Me-18), 1.12 (3H, s, Me-19), 4.65 (1H, d, J = 9.5 Hz, H-20a), 4.18 (1H, dd, J = 1.5, 9.5 Hz, H-20b); $^{13}\text{C NMR}$ (100 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 198.6 (s, C-1), 127.9 (d, C-2), 161.5 (d, C-3), 36.1 (s, C-4), 55.6 (d, C-5), 73.6 (d, C-6), 97.8 (s, C-7), 53.4 (s, C-8), 41.4 (d, C-9), 46.8 (s, C-10), 18.4 (t, C-11), 33.1 (t, C-12), 36.3 (d, C-13), 26.5 (t, C-14), 75.4 (d, C-15), 160.1 (s, C-16), 107.9 (t, C-17), 30.1 (q, C-18), 24.5 (q, C-19), 65.4 (t, C-20).

Maoecrystal Q (**6**), $\text{C}_{21}\text{H}_{28}\text{O}_6$; mp 180 ~ 182 °C; $\text{UV}_{\text{max}}^{\text{MeOH}}$ 227 nm; $\text{IR}_{\text{max}}^{\text{KBr}} \text{cm}^{-1}$: 3250, 2940, 1710, 1656, 1485, 1370, 1300, 1265, 1160, 1104; positive FABMS m/z (%): 377 [M + H]⁺ (100); $^1\text{H NMR}$ (500 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 5.96 (1H, d, J = 10.1 Hz, H-2), 6.68 (1H, d, J = 10.1 Hz, H-3), 4.26 (1H, dd, J = 7.7, 11.0 Hz, H-6 α), 1.98 (1H, dd, J = 4.8, 13.6 Hz, H-9 β), 2.64 (1H, m, H-13 α), 2.89 (1H, m, H-16 α), 3.67 (2H, m, H-17a, b), 1.34 (3H, s, Me-18), 1.07 (3H, s, Me-19), 4.52 (1H, d, J = 9.8 Hz, H-20a), 4.11 (1H, d, J = 9.8 Hz, H-20b), 3.21 (3H, s, OCH_3), 6.12 (1H, d, J = 11.0 Hz, OH-6 β); $^{13}\text{C NMR}$ (125 MHz, $\text{C}_5\text{D}_5\text{N}$): δ 197.4 (s, C-1), 127.4 (d, C-2), 160.7 (d, C-3), 36.1 (s, C-4), 56.6 (d, C-5), 73.5 (d, C-6), 96.3 (s, C-7), 61.1 (s, C-8), 47.9 (d, C-9), 46.2 (s, C-10), 19.3 (t, C-11), 19.9 (t, C-12), 29.7 (d, C-13), 28.1 (t, C-14), 222.6 (s, C-15), 59.3 (d, C-16), 69.0 (t, C-17), 30.0 (q, C-18), 24.2 (q,

C-19), 65.6 (t, C-20), 58.6 (q, OCH₃).

Eriocalyxin B (**7**), C₂₀H₂₄O₅; mp 210 ~ 212 °C; UV^{MeOH}_{max} 234 nm; IR^{KBr}_{max} cm⁻¹: 3300, 3210, 2908, 1695, 1645, 1300, 1253, 1070, 1050; EIMS (70 eV) m/z (%): 344 [M]⁺ (64), 326 [M - H₂O]⁺ (40), 311 (46), 298 (23), 255 (18), 165 (70), 163 (100), 135 (56); ¹H NMR (400 MHz, C₅D₅N): δ 6.00 (1H, d, J = 10.0 Hz, H-2), 6.70 (1H, d, J = 10.0 Hz, H-3), 4.32 (1H, d, J = 8.4 Hz, H-6α), 6.01 (1H, br s, H-17a), 5.34 (1H, br s, H-17b), 1.39 (3H, s, Me-18), 1.08 (3H, s, Me-19), 4.53 (1H, d, J = 9.8 Hz, H-20a), 4.14 (1H, dd, J = 1.4, 9.8 Hz, H-20b); ¹³C NMR (100 MHz, C₅D₅N): δ 197.3 (s, C-1), 127.4 (d, C-2), 160.9 (d, C-3), 36.1 (s, C-4), 58.5 (d, C-5), 73.6 (d, C-6), 96.7 (s, C-7), 60.4 (s, C-8), 48.4 (d, C-9), 46.7 (s, C-10), 19.6 (t, C-11), 30.0 (t, C-12), 34.8 (d, C-13), 25.9 (t, C-14), 209.2 (s, C-15), 153.7 (s, C-16), 117.7 (t, C-17), 30.2 (q, C-18), 24.5 (q, C-19), 65.5 (t, C-20).

Cirsimaritin (**8**), C₁₇H₁₄O₆; EIMS (70 eV) m/z (%): 314 [M]⁺ (100), 299 (95), 285 (31), 271 (40), 181 (26), 153 (54), 119 (21), 69 (50); ¹H NMR (400 MHz, C₅D₅N): δ 6.82 (1H, s, H-3), 6.94 (1H, s, H-8), 7.97 (2H, d, J = 8.8 Hz, H-2', 6'), 7.31 (2H, d, J = 8.8 Hz, H-3', 5'), 4.00 (3H, s, OMe), 3.92 (3H, s, OMe); ¹³C NMR (100 MHz, C₅D₅N): δ 165.1 (s, C-2), 103.9 (d, C-3), 183.3 (s, C-4), 153.7 (s, C-5), 129.1 (s, C-6), 159.5 (s, C-7), 91.8 (d, C-8), 153.6 (s, C-9), 106.5 (s, C-10), 122.4 (s, C-1'), 129.1 (d, C-2', 6'), 117.1 (d, C-3', 5'), 163.0 (s, C-4'), 60.7 (q, OMe), 56.6 (q, OMe).

2α-hydroxyursolic acid (**9**), C₃₀H₄₈O₄; EIMS (70 eV, m/z) data and R_f value on TLC are consistent with those of authentic sample.

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